What is claimed is:

1. An optical delay line for use with an optical source comprising:

input/output optics optically coupled to the optical source to direct light from the optical source along a delay line beam path and to direct delayed light from the delay line beam path along an output beam path, the delay line beam path being tangent to an edge of an evolute circle of the optical delay line; and

a curved mirror with an inner reflective surface having a curvature based on an involute curve calculated from the evolute circle, the curved mirror being centered on an axis of the evolute circle to retro-reflect light traveling along the delay line beam path,

wherein at least one of the input/output optics and/or the curved mirror rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line.

2. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a planar cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a beam splitter to i) couple the light from the optical source into the optical delay line along the axis of the evolute circle and ii) couple the delayed light out of the optical delay line along the output beam path;

a first mirror at a center of the evolute circle arranged to i) reflect the light from the optical source along a radius of the evolute circle and ii) reflect the delayed light along the axis of the evolute circle; and

a second mirror on the edge of the evolute circle arranged to i) reflect the light from the radius of the evolute circle along the delay line beam path and ii) reflect the delayed light along the radius of the evolute circle.

3. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a chevron cross-sectional shape in a plane perpendicular to the evolute circle;

the light from the optical source is coupled into the optical delay line along the axis of the evolute circle from a first side; and

the input/output optics comprise:

a first mirror at a center of the evolute circle arranged to reflect the light from the optical source along a first radius of the evolute circle;

a second mirror on the edge of the evolute circle arranged to i) reflect the light from the first radius of the evolute circle along a first arm of the delay line beam path and ii) reflect the delayed light from a second arm of the delay line beam path along a second radius of the evolute circle, the first arm of the delay line beam path being parallel to the second arm of the delay line beam path and offset in a direction parallel to the axis of the evolute circle, and the first radius of the evolute circle being parallel to the second radius of the evolute circle and offset in the direction parallel to the axis of the evolute circle; and

a third mirror at the center of the evolute circle arranged to reflect the delayed light from the second radius of the evolute circle along the axis of the evolute circle from a second side.

4. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a planar cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a beam splitter to i) couple the light from the optical source into the optical delay line and ii) couple the delayed light out of the optical delay line along the output beam path; and

an optical fiber having a first end optically coupled to the beam splitter and a second end on the edge of the evolute circle arranged to i) direct the light to the curved mirror along the delay line beam path and ii) receive the delayed

light reflect by the curved mirror.

5. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a chevron cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a first optical fiber having a first input end optically coupled to the optical source and a first output end on the edge of the evolute circle arranged to direct the light to the curved mirror along a first arm of the delay line beam path; and

a second optical fiber having a second input end on the edge of the evolute circle arranged to receive the delayed light reflected by the curved mirror along a second arm of the delay line beam path and a second output end to couple the delayed light out of the optical delay line.

6. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a planar cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a beam splitter to i) couple the light from the optical source into the optical delay line and ii) couple the delayed light out of the optical delay line along the output beam path; and

a planar waveguide structure having a first end optically coupled to the beam splitter and a second end on the edge of the evolute circle arranged to i) direct the light to the curved mirror along the delay line beam path and ii) receive the delayed light reflect by the curved mirror.

7. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror has a chevron cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a first planar waveguide structure having a first input end optically coupled to the optical source and a first output end on the edge of the evolute circle arranged to direct the light to the curved mirror along a first arm of the delay line beam path; and

a second planar waveguide structure having a second input end on the edge of the evolute circle arranged to receive the delayed light reflect by the curved mirror along a second arm of the delay line beam path and a second output end to couple the delayed light out of the optical delay line.

8. The optical delay line of claim 1, wherein the input/output optics comprise diverging optics to substantially compensate for a curvature of the inner reflective surface of the curved mirror in a plane parallel to the evolute circle.

9. The optical delay line of claim 1, wherein the inner reflective surface of the curved mirror comprises an integral number, N, of substantially identical sections, the curvature of each substantially identical section based on the involute curve calculated from the evolute circle over a range of angles from θ_0 to $\theta_0+2\pi/N$.

10. The optical delay line of claim 1, further comprising:

a controllable rotation stage coupled to one of the input/output optics and/or the curved mirror; and

a processor electrically coupled to the high precision, controllable rotation stage to control a rotation speed of the high precision, controllable rotation stage, thereby controlling a rate of change of the delay of the optical delay line.

11. The optical delay line of claim 1, wherein:

only the curved mirror rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line;

the inner reflective surface of the curved mirror has a planar cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise:

a beam splitter to i) couple the light from the optical source into the optical delay line and ii) couple the delayed light out of the optical delay line

along the output beam path; and

a mirror located along a tangent of the evolute circle arranged to i) reflect the light from the beam splitter along the delay line beam path and ii) reflect the delayed light to the beam splitter.

12. The optical delay line of claim 1, wherein:

only the curved mirror rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line;

the inner reflective surface of the curved mirror has a chevron cross-sectional shape in a plane perpendicular to the evolute circle;

the light from the optical source are coupled into the optical delay line from a first side of the evolute circle; and

the input/output optics comprise:

a first mirror located along a first tangent of the evolute circle arranged to reflect the light from the optical source along a first arm of the delay line beam path; and

a second mirror located along a second tangent of the evolute circle arranged to reflect the delayed light from a second arm of the delay line beam path along the output beam path, the first tangent of the evolute circle being parallel to the second tangent of the evolute circle and offset in a direction parallel to the axis of the evolute circle, the first arm of the delay line beam path being parallel to the second arm of the delay line beam path and offset in the direction parallel to the axis of the evolute circle, and the output beam path extending from the second side of the evolute circle.

13. The optical delay line of claim 1, wherein:

the inner reflective surface of the curved mirror extends around the evolute circle over an angular range of less than 2π such that a gap is formed in the inner reflective surface;

the curved mirror comprises a detector disposed in the gap in the inner reflective surface to detect light incident on the gap and provide a signal; and

a processor to determine a repetition rate of the optical delay line from the detector.

14. The optical delay line of claim 1, wherein the optical source is a pulsed optical source.

15. The optical delay line of claim 1, wherein the optical source is a laser source.

16. An optical delay line for use with an optical source comprising:

input/output optics optically coupled to the optical source to direct light from the optical source along a delay line beam path and to direct delayed light from the delay line beam path along an output beam path, the delay line beam path being tangent to an edge of a evolute circle of the optical delay line; and

a curved mirror with an outer reflective surface having a curvature based on an involute curve calculated from the evolute circle, the curved mirror being centered on an axis of the evolute circle to retro-reflect the light traveling along the delay line beam path,

wherein the curved mirror rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line.

17. The optical delay line of claim 16, wherein:

the outer reflective surface of the curved mirror has a planar cross-sectional shape in a plane perpendicular to the evolute circle; and

the input/output optics comprise a beam splitter to i) couple the light from the optical source into the optical delay line along the axis of the evolute circle and ii) couple the delayed light out of the optical delay line along the output beam path.

18. The optical delay line of claim 16, wherein:

the outer reflective surface of the curved mirror has a chevron cross-sectional shape in a plane perpendicular to the evolute circle;

the input/output optics couple the light from the optical source along a first arm of the delay line beam path; and

the input/output optics couple the light from a second arm of the delay line beam path along the output beam path, the first arm of the delay line beam path being parallel to the second arm of the delay line beam path and offset in a direction parallel to the axis of the evolute circle.

19. The optical delay line of claim 16, wherein the input/output optics comprise converging optics to substantially compensate for a curvature of the outer reflective surface of the curved mirror in a plane parallel to the evolute circle.

20. The optical delay line of claim 16, wherein the outer reflective surface of the curved mirror comprises an integral number of substantially identical sections, N, the curvature of each substantially identical section based on the involute curve calculated from the evolute circle over a range of angles from θ_0 to $\theta_0+2*\Pi/N$.

21. The optical delay line of claim 16, further comprising:

a controllable rotation stage coupled to the curved mirror; and

a processor electrically coupled to the controllable rotation stage to control a rotation speed of the controllable rotation stage, thereby controlling a rate of change of the delay of the optical delay line.

22. The optical delay line of claim 16, wherein:

the outer reflective surface of the curved mirror extends around the evolute circle over an angular range of less than 2Π such that a gap is formed in the outer reflective surface;

the curved mirror comprises a detector disposed in the gap in the outer reflective surface to detect light incident on the gap and provide a signal; and

a processor to determine a repetition rate of the optical delay line from the detector.

23. The optical delay line of claim 16, wherein the optical source is a pulsed optical source.

24. The optical delay line of claim 16, wherein the optical source is a laser source.

25. An optical delay line for use with an optical source comprising:

input/output optics optically coupled to the optical source to direct light from the optical source along a delay line beam path and to direct delayed light from the delay line beam path along an output beam path, the delay line beam path being tangent to an edge of an evolute curve of the optical delay line; and

a curved mirror with a reflective surface being centered about the evolute curve to retro-reflect the light traveling along the delay line beam path,

wherein at least one of the input/output optics and/or the curved mirror rotates about the evolute curve at a selected angular speed and the reflective surface has a curvature based on a parametric curve calculated from the evolute curve such that a delay of the optical delay line varies according to a predetermined function as the at least one of the input/output optics and/or the curved mirror is rotated.

26. The optical delay line of claim 25, wherein the predetermined function is a non-linear function of a rotation angle of the at least one of the input/output optics and/or the curved mirror.

27. An optical delay line for use with an optical source comprising:

input/output means for directing light from the optical source along a delay line beam path and for directing delayed light from the delay line beam path along an output beam path, the delay line beam path being tangent to an edge of an evolute circle of the optical delay line; and

mirror means with an inner reflective surface having a curvature based on an involute curve calculated from the evolute circle, and centered on an axis of the evolute circle to retro-reflect light traveling along the delay line beam path,

wherein at least one of the input/output means and/or the mirror means rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line.

28. An optical delay line for use with an optical source comprising:

input/output means for directing light from the optical source along a delay line beam path and for directing delayed light from the delay line beam path along an output beam path, the delay line beam path being tangent to an edge of a evolute circle of the optical delay line; and

mirror means with an outer reflective surface having a curvature based on an involute curve calculated from the evolute circle, and centered on an axis of the evolute circle to retro-reflect the light traveling along the delay line beam path,

wherein the mirror means rotates about the axis of the evolute circle to controllably vary the delay of the optical delay line.